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Watershed Systems
Hydrology - Geology - Soil Science

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November 16, 1998

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BY:

Gentlemen,

The attached review represents a contribution that specifically reviews forest hydrology, cumulative hydrologic effects, and other hydrologic issues as they may impinge on fish and riparian species habitats in the Palco HCP/SYP. This is not intended to be comprehensive in terms of hydrology.

Sincerely

Robert R. Curry
Registered Geologist and Hydrologist

PALCO SYP/HCP REVIEW

Robert R. Curry, PhD

November 12, 1998

Overview of Response:

This assessment of the Pacific Lumber Company Sustained Yield Plan and Habitat Conservation Plan focuses on the hydrologic aspects of the proposed plan. It is not intended to be comprehensive in this area, but to merely illustrate some of the shortcomings of the existing PalCo document. All reviewed documents have been derived in November of 1998 from the CERES web site maintained by the State of California. These include the PalCo SYP/HCP and associated documents, including its color maps, and the Draft Environmental Impact Report for the Headwaters Forest Acquisition and the PalCo Sustained Yield Plan and Habitat Conservation Plan of October, 1998. Some PalCo lands have also been visited in the field in August, 1998, and many of the proposed and active Timber Harvest Plans, as well as mitigation activities in progress under PalCo administration, have been reviewed.

This response covers some areas of forest hydrology, cumulative hydrologic effects, and sediment yield only. These timber-harvest related fields of watershed science most directly affect the adequacy of the PalCo HCP as it attempts to address impacts of the proposed activities and the proposed conservation strategies for fish species that inhabit or utilize the PalCo lands and those downstream river areas that are directly affected by activities on PalCo lands. My comments also go to the adequacy of the database and assumptions upon which the Sustained Yield Plan is based.

I am a Registered California Geologist specializing in watershed sciences, especially fluvial geomorphology and sediment transport hydrology. I have over 40 years of University-level teaching experience in Watershed Science and am currently a Research Professor at the University of California Santa Cruz where my graduate students are enrolled. I am also Research Director of the California State University Watershed Institute that is aligned with the Earth Systems Science program at California State University Monterey Bay, where I teach undergraduate courses in hydrology, geology, watershed restoration, soil science, and water resources. I have had extensive professional experience in the Headwaters Forest area and the Redwood Creek watershed, as well as the Six-Rivers and nearby National Forests. I helped draft the California Forest Practices Act in the 1960's.

Primary Areas of Hydrologic Concern with the PalCo HCP/SYP:

Overview: Evidence of understanding and assessment of many primary areas of basic forest watershed science is not seen in the PalCo SYP/HCP. Treatments of most areas of basic hydrology, downstream cumulative effects, sediment yield and delivery to water courses, and the role of upland conditions as they may affect hydrology are either extremely weak, deferred to the future, or simply ignored altogether in the PalCo document. This is the single area of inquiry that is probably the most important in

determining the adequacy of a Habit Conservation Plan for salmonid species, but it appears that the persons drafting the SYP/HCP have focused more on ancillary areas and a far-too-simple concept of salmonid habitats that link fine sediment yield and spawning habitats while ignoring the multiple fundamental issues of runoff timing, flood frequency, fluvial geomorphology (river channel stability), and stream equilibrium. The overall approach of the HCP seems to be to try to convince the reader that PalCo has chosen and carefully assessed the adequacy of the brand of Band-Aid that will be placed in the first-aid kits to be stationed in each watershed, rather than addressing the causes and prevention of the injuries and deaths that will likely occur to the species that are present.

1. The hydrologic issues associated with conversion of late serial stage and old-growth redwood and mixed conifer forest to a dominant even-aged Douglas Fir commercial forest type are not addressed. These include significant impacts on fog-drip soil moisture, interception losses of precipitation, root strength and slope stability induced by root arching, downstream cumulative effects on flood hazards, and timing of runoff as it affects water use by salmonids, humans and other species of concern.

2. The hydrologic impacts of timber harvest on upland slopes as they affect runoff and sediment generation in Class III watercourses and all downstream higher-order streams is very inadequately considered.

3. The myths of "streamside buffer strips" are perpetuated in the PalCo SYP/HCP, especially the beliefs that no-cut or limited-entry streamside zones and riparian areas somehow filter fine sediments or all sediments to prevent their entry to watercourses. This is a major focus of the PalCo document, but is without technical foundation for habitat protection and salmonid take.

4. The hydrologic impacts of forest type conversion and accelerated timber harvest on landslide and other slope stability issues is not adequately addressed and is based on faulty reasoning.

5. The watershed assessment areas (WAA's) do not comprise logical units that are designed to assess impacts and protect target riparian and watercourse species.

6. The Riparian Management Zone (RMZ) concept is very faulty, does not address actual riparian conditions or zones, and is very misleading.

7. The Aquatic Habitat Conservation Strategy as a whole is not presented in a fashion that allows technical review of its merits. The concepts of limits (called sideboards) that could occur after a strategy is developed do not permit public review of the potential adequacy of the plan because the strategy itself is not revealed.

8. Watershed Analysis itself has not been accomplished and cannot be assessed in the present documents. The cumulative impacts portion of the Washington State methodology that is purported to be applicable for Watershed Analysis is not, apparently, to be applied in the PalCo ownership despite the fact that, for different reasons, its methodology may be entirely applicable (rain-on-snow impact increases in Washington vs effective precipitation increases in N. California). The absence of any reasonable analysis at the present time renders the present document invalid.

9. Watershed Assessment is not covered in Volume II that bears that title. This should be the core of the HCP, but it is missing. There is no watershed geomorphic sensitivity analysis, but only a very inadequate framework that belies the fact that the authors do not understand even the concepts of stream channel sensitivity, hillslope sensitivity, or watershed sensitivity. These are measures of the state of equilibrium or disequilibrium of these landscape units, and not what are covered or outlined as a "framework" in Vol II, Parts D & E, and Appendices.

10. Roads and roading impacts are not assessed in any rational manner. Road restoration and "storm proofing" are mistakenly assumed to mitigate or eliminate many impacts, such as increased runoff coefficients. The existing road densities in watersheds like Freshwater far exceed the natural watercourse densities, and will thus already have thoroughly disequilibrated the natural channels. Concepts of watershed dynamics including such things as the times necessary for watersheds to develop characteristics that demonstrate existing metastable conditions seem altogether absent from the entire HCP/SYP, as do concepts of times necessary for natural restoration of pool volumes or adequate spawning redd conditions.

11. Landslide and flood assessments and proscriptions are conditioned on unforeseen or changed circumstances that PalCo attempts to describe in ways that would permit changes in their management responses in the event of 50-year or 100-year return interval magnitude events. Such events are perfectly "foreseeable", not easily classed as having exceeded such a frequency until after the fact, if then, and do not, contrary to PalCo's assumptions, occur in isolation in only one or a few watersheds at one time. The thresholds do not make sense, and comprise an attempt to avoid accepting responsibility for the human-induced component of natural events.

Discussion of topics:

1. The proposed cutting schedule, with highly accelerated initial cutting (34,903 acres of clearcut out of 54,382 acres harvested in the first decade (27 percent of the PalCo holdings) will have very significant hydrologic impact that directly affects salmonids and other species. Completely unaddressed are the issues of the effects of such a cut schedule on effective precipitation (rainfall that reaches the ground where it may become runoff). Professional colleague Dr. Leslie Reid in her response to the PALCO SYP/HCP will address this issue in more detail.

RRC-1

Interception losses occur when rainfall is evaporated from vegetation before ever reaching the ground to become runoff or recharge. Foresters often cite evapotranspiration as the causes of decreased runoff from a well-forested subwatershed as compared with one recently cut over or partly deforested. But measuring total evapotranspiration from a forest is virtually impossible. Interception losses are easily measured by simply measuring rainfall under a tree canopy and comparing it to that outside the canopy. Recent work (see cites by Leslie Reid) demonstrate that 30 to 50 percent of storm precipitation may be intercepted in high-rainfall high-intensity storm sites. When a forest canopy is removed in any significant proportion, the "leaf area index" decreases and interception losses also therefore decrease. This happens even in cold wet climates because air near the ground or even near a water surface is not completely saturated (100% humidity). An air mass at 90% humidity can still hold the equivalent of several inches more precipitation if there is a large surface area to intercept and evaporate it. Forest cutting reduces the

leaf area index by orders of magnitude. This effect has been measured on PalCo lands in an older Master's thesis effort at Humboldt State University.

RRC-1 CON.

According to Dr. Reid's analysis (personal communication) the effect of a modest and conservative 22 percent increase in effective precipitation results in about a doubling of flood frequency for the mean annual winter floods and as much as a 250% increase in landslide volumes moving into watercourses. When such an effect is coupled with the compounding effects of increased sediment yield and resulting increases in stream aggradation (coarse sediment accumulation in the streambed) as noted by Harvey Kelsey for sites below the PalCo holdings[1], and as noted in the data collected for Freshwater Creek for the comparative channel cross section surveys of 1975 and 1998[2], we end up with a combined effect for the first decade of 4-times the frequency of floods of any given magnitude below PalCo ownership in Freshwater Creek[3]. The sedimentation effects that reduce cross-sectional area will persist much longer than the timber harvest effects. These sedimentation effects are largely gravel pool fillings, thus reducing habitat independent of fine-grained sediment yield that is the primary focus of the PalCo HCP effort. In landslide-prone terrain, the increased coarse sediment yield that results from the increased soil moisture and increased depth of saturation associated with the combined effect of decreased interception losses and decreased evapotranspiration all combine to compound the downstream, offsite cumulative effects of timber harvest as outlined in the PalCo document. Where is the analysis? How have the already-disequilibrated streams like Freshwater been factored into the SYP/HCP? Why are more new roads proposed for this already most over-roaded watershed? This is a prime example of the failure of the PalCo document to address hydrologic effects, whether obvious, like fog drip, or more subtle, such as increased flooding. The conditions studied in detail in Freshwater Creek are typical of those for most of the PalCo ownership, and the conclusions I draw from Freshwater apply to all other cutover and roaded watersheds.

2. CDF Class III watercourses are subject to a locally applied equipment limitation but do not have any riparian zone protection. In fact, most PalCo Class III stream courses have relatively little true riparian habitat because they are too steep in gradient to create permanently saturated soils or to support riparian species except immediately adjacent to the watercourse. But that whole approach is bogus. The steeper the gradient on the watercourse, the more easily sediment is transported down it. Class III watercourses and the smaller "zero order" watersheds above them are the primary funnels through which the majority of sediments are passed to Class II and Class I streams. What happens on the upland slopes directly affects the Class III sediment yield. Because of the steep gradients, sediment does not accumulate from year to year in Class III watercourses, but it passes through none-the-less. A riparian filter strip along a Class II or Class I stream does not in any way restrain the input of sediment from uplands through Class III channels. That sediment moves primarily in large storm events. Its movement and input to larger streams is very episodic. One cannot

RRC-2

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[1] Kelsey, H.M., 1987, Geomorphic Processes in Recently Uplifted Coast Ranges of Northern California; PP 550-581 *in* W. L. Graf (ed) **Geomorphic Systems of North America**, Centennial Special Volume 2, Geological Society of America, Boulder, Colo.

[2] Internal CDF memo of Sept. 11, 1998 from Pete Cafferata to Dave Ebert – see especially Fig. 7 Cross Section.

[3] Because winter flood volumes are larger than in a natural watershed, floods of a given magnitude become more numerous. Also, floods of a given frequency are of greater magnitude. The effect is probably proportionally greater for lower magnitude floods

go out after a storm and assess what has moved in a Class III watercourse. That takes synoptic on-site mid-winter, mid-storm sampling as was done in Redwood Creek by the US Geological Survey to determine the sources of mainstem sediment. PalCo's approach and entire philosophy is completely contrary to basic watershed science. Simple (in concept) mid-winter monitoring as was done by the USGS can easily demonstrate the fallacy of the idea that upslope activities can be mitigated by protecting Class II and Class I watercourses.

RRC-2 con.

3. Streamside buffers that PalCo calls Riparian Management Zones are useful for protecting stream water temperatures, for providing inputs of carbon to the aquatic food chain, for recruiting large woody debris, and, for the very limited PalCo sites with floodplains, for enhancing stream water quality. But they do NOT filter out sediment. Where there is a decrease in slope steepness as on a bench or streamside floodplain, sediment may be temporarily captured and stored until the stream floods or until the bench is filled to a transportation gradient, which is seldom more than a few decades.

RRC-3

Most watercourses of any CDF class on PalCo ownership are incised with an inner channel. It is technically an inner gorge, but may be only 3 or 4 feet deep. Above that there may be a tectonically induced inner gorge of several 10's to several hundreds of feet depth, or there may be a bedrock-controlled canyon wall of any steepness hundreds to one-thousand feet in vertical extent. I would estimate that at least 90 percent of the watercourse length on PalCo lands is incised. Only flood flows will reach the top of that incision. These are not alluvial terraces in most cases, but are shallow mass-wasting and soil creep dominated slopes that actively balance sediment supplied from the hillslopes to that transported to the watercourses. There is no net filtration or stopping of sediment transport, even through a dense willow, alder, and conifer closed canopy. Few midwinter studies quantify this, although I have done so in the Santa Cruz Mountains in mixed redwood and Douglas fir on slopes less steep than the averages in PalCo ownership[4].

The limitation of activity within RMZ's, as proposed by PalCo, can protect water temperature but cannot protect against discharge of sediment to the watercourse. If it could accomplish this task, watercourses with such protective zones would today be seen to have accumulated hillslope sediments in streamside levees or benches. These are not seen along streams in the PalCo ownership. All arguments about widths and measurement of those widths as horizontal distances or slope distances should be based on shading, wood recruitment, and food sources and habitats, but not on filtration. There are sound reasons to support the RMZ concept, even if PalCo is misusing the concept of the word "riparian". But it is not a sediment control strategy and does not reduce sediment delivery ratios except in a very short-term (hourly) fashion at the beginning of major sediment-yielding storms.

4. Landslides are categorized in the PalCo document for only some of their ownership (illustrated on Map 13). As the text describes, this is primarily an overlay of topography on known geology, and where that very generalized geology is not known (see Map 9), no inference is made. Map 11 transcribes some of the so-called Spittler maps from

RRC-4

[4]) Curry, R.R., 1987, Water quality protection in forest management: Are Best Management Practices working?, pp. 55-61 *in* Callaham, R.Z., and J.J. DeVries (eds), Proceed. of the California Watershed Management Conference, Nov. 18-20, Sacramento, Calif. Wildland Resources Center, Univ. Calif., Berkeley, Rept. 11, 167 p.

DMG and is probably more useful than the Hazard Index of Map 13. It should be noted that these two presentations do not coincide. Mapped disrupted ground, unstable areas and slides do not necessarily coincide with extreme hazard indices. Other very unstable slopes that are active today, such as those bordering the PalCo plant site in Yager Creek, are depicted as low or very low hazard and are unmapped by Tom Spittler, yet are clearly active. The Hazard Index discounts them because they are not on very steep slopes and are generalized as geologically more stable.

RRC-4 con.

The primary problem with landslides, as with floods, is that harvest is scheduled to take place on unmapped sites where stability has only been inferred from a very inadequate database. Individual THPs are prepared for most sites, like for the ongoing active cutting on Yager Creek, where only very obvious active slides are noted in the THP maps as required by CDF. By linking a SYP/HCP to predicted photo- or field-based or CDF-mandated THP-scale mapping that will be conducted in the future forces us to accept a SYP today that cannot assure habitat protection. Because inner-gorges are ill-defined, as are amphitheater-headed slopes, and because forest cover generally masks accurate photo-interpretation, this area of the HCP is weak. Add to that the markedly increased soil water loading associated with reduced interception losses in cut-over areas, and the great change in slope loading associated with roads and road runoff, and one must conclude that the use of past geologic stability to predict future slope instability becomes virtually impossible. That is not to say that such mapping should not be continued and that its output should not be used fully for timber management, but one should not believe that such mapping is deterministic or that PalCo can protect and reduce take of Coho salmon with their proposed plan.

Where production of Douglas Fir is to be encouraged in place of stump-sprout species such as redwood, slope stability may be compromised in sites where root arching comprises an important element of slope strength[5]. Because species conversions will occur with the proposed SYP on some PalCo lands, and because Douglas-Fir roots rot out within a few years after cutting, but redwood and other stump-sprout species do not, hillslope soils have less shear strength and are more prone to debris slides when harvested as proposed by PalCo.

Particularly difficult to justify is the enormous loophole provided by the caveats associated with extreme events of 50 and 100-year return periods. Climate is not fixed, and neither are the magnitudes of events of a given return period. Storms of about a 20-year return period based on the past 40 years of data tend to cause major damage in some watersheds that are already overloaded with sediment input relative to their transport capacity. An example is Freshwater Creek[6]. In the same watershed, a "100-year" event (i.e., one "larger than ever recorded" or comparable to 1955 or 1964 events) may reset the geomorphic clock by sluicing out the excess stored sediment and restoring conditions that permit subsequent development of a good pool and riffle habitat sequence that could support spawning and rearing of salmonids. Alternatively, in the balanced watershed where sediment delivery to the stream equals its ability to transport that sediment, only a 20-year event may clean the channel and reset pool volumes if large woody debris recruitment is adequate. The proposed "changed" and "unforeseen" circumstances (Vol. IV, Part H, pp 8-11) are really simply a way to avoid

RRC-5

[5] Donald H. Gray, Biotechnical Slope Protection and prior papers (personal communication).
[6] Calif. Dept. of Forestry, 1997, Coho salmon (*Oncorhynchus kisutch*) considerations for timber harvesting under the California Forest Practice Rules, Sacramento, April 29, 49p. Freshwater and other PalCo watershed are classed as already impacted by excess sediment in terms of Coho habitat.

dealing with certain episodic events that would likely affect much or all of PalCo ownership simultaneously[7]. The natural mosaic of forested watersheds is also impacted simultaneously by major events, but some portion of those channels and watersheds will hold while many fail in the sense that salmonid reproductive success is greatly reduced for 4 or more years. But it is these few areas that hold and can therefore maintain the gene pools (salmon genetic stock). An effective SYP/HCP must address keeping some balanced watersheds fully intact to assist, but not guarantee, species survival during major flood and associated landslide events. RRC-5 con.

5. The Watershed Assessment areas suffer from the same shortcomings as do the statewide CDF watershed units. They are either often not whole watersheds or they include multiple subwatersheds that are not hydraulically continuous. For example, the Freshwater Creek unit of the Humboldt WAA and North Fork Yager Creek part of the Yager WAA both include separate adjacent watersheds. Impacts in one subunit do not necessarily cumulatively accrue to the same stream as do those in the adjacent subunit. This means that, if true cumulative hydrologic effects were to actually be assessed at some future date for a real SYP/HCP, it would be possible to stage cutting such that it far exceeded the capacity of one of the subwatershed units without being apparent to a THP reviewer. In fact, assessment sub-units must in some cases be significantly smaller than the ideal sizes outlined in Map 3. RRC-6

   Also, the large areas of watersheds that pass through PalCo ownership but originate outside of it must be dealt with in a systematic fashion that protects the resources. Salmonids do not know who the property owners may be, or who was responsible for losses of residual pool volumes by the gravels that fill the pools in their natal streams. Multiple ownerships are difficult issues for cumulative hydrologic effects analyses. The proposed cut and conversion times seem far too accelerated to be able to accommodate similar activities on adjacent non-PalCo headwaters. This is then a fatal flaw in any watershed assessment. One cannot develop a SYP and cutting plan until a strategy is developed to assess and accommodate anticipated or potential changes on adjacent ownerships. The proposed buffer land considerations, as illustrated for example in the PalCo Map 4, are not watershed boundary based nor does the treatment of adjacent non-PalCo timberlands address cumulative hydrologic effects of PalCo's actions in light of what may occur upstream. The 1998 Foster-Wheeler Corporation data cited in the dEIR, Chapter 3.7, do break down the watersheds by ownership and by forest land type. Those data do not appear to differentiate between forest lands upstream of PalCo and those downstream, but PalCo's maps suggest that most of the Foster-Wheeler non-PalCo forest lands are upstream and thus would cumulatively limit potential disturbances on PalCo lands.

6. Riparian zones, as defined in the basic California literature[8], serve many functions. Most of those are of benefit to organisms that inhabit riparian or stream habitats. It is important to realize that the concept of riparian management zones as used in the PalCo document, is more closely similar to the SMZ or streamside management zone concept of CDF in that it is a fixed width (properly measured horizontally to allow tree- RRC-7

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[7] Major storms in northern California affect all the watersheds in a region simultaneously. These are times when fish populations are stressed and may have low reproductive success. The resiliance of a few watercourses to such major events is thus vital to survival of the site-adapted genetic fish stock.

[8] Warner, R.E. and K.M. Hendrix (eds), California Riparian Systems, Univ. Calif. Press, Los Angeles.

height to predict shading and woody recruitment), rather than having anything to do with riparian habitats. Water quality improvement is not a characteristic of most streamside zones on most PalCo lands. The exceptions are those floodplain or immediate streamside areas or wet seep areas where seasonal or year-around reducing conditions may exist beneath the soil surface. The primary focus of the PalCo SYP/HCP on their RMZ zonation should be reconsidered in light of actual analysis of functional streamside and riparian habitats. Harvest or conversion of stand types on hillslopes far from Class II watercourses will still increase runoff down slopes and Class III watercourses and gullies and will still mobilize hillslope sediments to reach primary watercourses. Detailed prescriptions in Class I and II watercourse borderlands will not protect those streams from sediment equilibrium changes. Treatment of bare areas within streamside zones does not change the rate of delivery of the bulk of the sediment to those streams. You cannot make an overloaded truck safe to operate simply by repainting it.

RRC-7 con.

7. Too little is presented to permit fair assessment of Watershed Sensitivity or Watershed Analysis. We are told that a model will be developed based on modifications of the Washington State Forest Practices model[9]. The language of Vol II, parts D and E is too general and too vague to permit a critical review. We can see that analyses conducted for current THPs is not sufficiently sensitive to cull out potential damaging activities that the SYP says will be prevented. We can learn that Watershed Assessment does not intend to look at Class III watercourses where the bulk of hillslope sediment is derived[10]. But we are not even given general figures for the distribution of sediment sources by WAA in terms of hillslopes, landslides, and stream channels. How can any strategy to protect habitats and species be developed when the sediment sources are not identified? We are shown surface erosion hazards based on very generalized soil type and slope, but any harvest plans that are based on such a generalization cannot predict how changes in winter storm runoff frequency-magnitude will affect channel bank stability and thus slope stability on adjacent stream courses. It is the sensitivity of uplands and headwater Class III and Class II watercourses that provide the triggers that impact downstream habitats. Surface particle dislodgment and sediment transport by overland flow is important, but is only a small component of geomorphic stability. The state of balance between sediment supply and stream runoff or stream power is the critical variable. This can be assessed. We are neither told how it will be done or if it will be done. We therefore cannot determine if habitats will be protected, restored, or further damaged by the proposed actions.

RRC-8

8. –see above

9. –see above

10. Roads and watercourse road crossings are recognized in the HCP as primary contributors to watershed cumulative effects, to sediment input sources, and are recognized as impediments to fish migration (Vol. II, Part O). Road densities are

RRC-9

[9] PalCo memorandum from Jeff Barrett to Dan Opalach of 10/9/98 discussing the ways that the Washington Department of Natural Resources methodologies will be modified for the Freshwater Creek Watershed Analysis (being conducted by a University of California sponsored team). This "Freshwater Creek Science Team" study focuses on Cumulative Effects, as noted in the cover letters and attachments mailed by Hank Vaux to all participants on September 23, 1998. Some of the Washington DNR modules are proposed for adoption as appropriate but not the Cumulative Effects hydrologic modules.

[10] This is acknowledged in the federal draft EIR citing CDF, 1995, at pages 3.4-44 and –45.

tabulated, although the classes of roads so tabulated do not seem to be those necessary for cumulative hydrologic effects analysis on downstream habitats. Methods for road density tabulation are not clearly explained. Most critically, roads and road crossings do not cease to exist after a decade of non-use or after a decade of abandonment or decommissioning. Roads do not heal from a hydrologic and sediment-yield standpoint in a fixed short time, nor in a linear fashion. Dirt roads yield sediment and excess runoff, because of compaction, for many decades (usually taken as 30 to 40 years).

RRC-9 con.

PalCo has developed a strategy that attempts to reduce the equivalent roaded area of disturbance (called in the SYP/HCP "disturbance index" or DI) that is probably a sound approach in theory. But it is not yet based on data or defensible information or models. It appears to be based on a Delphi-model of opinion by unknown persons that does not correlate with general widely accepted information in any but the limited forest industry. In fact, many of the pulled culverts and storm-proofed or "pulled" water-barred and decommissioned roads may actually have a higher initial sediment yield per unit area than did the original inherited near-channel road. A regraded and recontoured road alignment or pulled inadequate culvert may prevent major damage in the event of a 20-year magnitude storm, but it may initially yield more sediment in average storms and average winters until a new stone pavement and new vegetation protects the surface. Thus, a period of healing may be necessary before a "restored" road can be counted as eliminated. All of this should be part of any cumulative hydrologic effects analysis or watershed analysis. Because this has not yet been accomplished, we cannot know if the strategy that will be chosen is valid. A ten-year complete recovery certainly is not valid.

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RECEIVED
NOV 16 1998
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Gentlemen,

The attached review represents a contribution that reviews specific issues of *Threshold of Significance* from Chapter 3.4 – Watersheds, Hydrology and Floodplains of the **draft EIR**. This is intended to be reviewed in the context of comments that I have submitted in the PalCo SYP/HCP This is not intended to be comprehensive in terms of hydrology nor in terms of all of the issues raised in Chapter 3.4.

Sincerely

Robert R. Curry
Registered Geologist and Hydrologist

Chapter 3.4 dEIR Review

Robert R. Curry, PhD

November 14, 1998

Overview of Issues:

The drafters of this EIR have attempted to establish a method of evaluating impacts of the proposed and comparative actions based on proposed tests for Thresholds of Significance. Because so much of the fundamental analysis depended on assessment of exceeding or not exceeding these proposed thresholds, their fundamental bases and premises must be critically reviewed. Because of the many interrelationships between the differing impacts evaluated for Thresholds of Significance, and because of the vague and inconclusive language and lack of specificity, I cannot evaluate these individually. I must attempt to determine if the premises upon which the reasoning is based are sound. They are not. The following comprise the primary considerations that appear not to have been evaluated or are presented in such a confused fashion as to not be professionally meaningful.

1. Some of the proposed criteria to establish thresholds of significance are based on the North Coast Regional Water Quality Control Board (NCRWQCB) Basin Plan standards (cf, turbidity, water temperature, dissolved oxygen, sediment as it affects beneficial uses). This is conceptually sound. but cannot be enforced or even monitored. While it may look OK in paper to proposed that thresholds will coincide with NCRWQCB standards, and that if those standards are exceeded, then a threshold is exceeded; in fact one cannot determine if such thresholds are exceeded. Mid-winter, mid-storm conditions are those that limit habitat from the standpoint of characteristics like turbidity and transport of fine sediment. These fine sediments are delivered to Class II and Class I streams largely from Class III streams during storm periods when hillslopes are saturated or nearly saturated, when inside road ditches are carrying runoff, and when rainsplash erosion is dislodging surface soil particles and entraining them in sheet and rill flows. It is both very difficult and dangerous to try to monitor these conditions on upland slopes or in the inner gorges of Class II watercourses below areas of silvicultural treatment. Sampling to determine sources of fine sediments in streams requires rather complex synoptic (simultaneous) protocols where samples of water are collected from the entire stream (not just the banks) at the same minute in time at several places above, within and below the area of potential sediment discharge. This is the method developed by the U.S. Geological Survey for assessing sediment inputs to Redwood Creek. It is not reasonable to expect such methods to be used to establish standards upon which water quality criteria are based on large private land holdings in mid-winter storm periods. Roads are not passable, camping and working conditions are very difficult, and logistic support is almost impossible – not to mention the liability that might accrue to the private landowners with teams of people working in stream courses among log jams during flooding. RRC-10
2. The proposed thresholds do not indicate a clear understanding of the sources of sediment that they propose to evaluate. All of the thresholds suffer from the same naïve technical understandings that characterize the PalCo SYP/HCP. Fine sediment is acknowledged to derive from roads, Class III watersheds and uplands, and RRC-11

RRC-11

hillslopes. But the proposed evaluation and establishment of thresholds seem to be based on the same faith or inherent unsupported belief system that those riparian streamside vegetative buffers or limited entry areas will somehow filter out the sediments that are being transported through them. As pointed out in my PalCo SYP/HCP review, there is neither physical on-the-ground evidence of such an imaginary effect of buffer strips (sometimes actually called filter strips by CDF), nor is there any after-the-fact sediment accumulation that would have to occur if such an effect did protect watercourses. The dEIR even proposes that Riparian Management Zones (RMZ') would "...probably protect DO (dissolved oxygen) levels" (p.3.4-44). Ie, if the buffer zone protects from sediment influx, it may maintain high dissolved oxygen in the stream. This is ludicrous. You cannot simultaneously do both. If overland flow cannot get through the buffer zone, then DO must decrease as the water goes underground to somehow reach the stream. This shows how uncritical the thinking is that has gone into this section on proposed thresholds.

Riparian management zone (RMZ) sediment control is a stated objective of many sections of the dEIR, without basis in fact that it can be effectively accomplished. Section 3.7, p. 43 discusses RMZ sediment control (presumably fine sediment) as distinct from bank stability (a source of coarse sediment). Most of the goals of riparian management can be linked to the benefits stated, but channel stability is only weakly linked and sediment control is not linked. Section 3.6.3.3. actually states that "While some hillslope erosion is unavoidable due to the nature of logging operations, the delivery to streams can be mitigated to a less than significant level". This is the crux of the inadequacy of the proposed threshold concepts. No support is given for this statement, due; we are told, to the site-specific nature of sources of erosion. This is unacceptable. This is geomorphically naïve. If sediment is dislodged on hillslopes by logging but can be mitigated somehow by forest practices, then it must be trapped somewhere for geologic time periods. If sediment production is equal to sediment delivery and that is equal to sediment transport away from the site by the stream, then an equilibrium watershed condition exists. The hillslopes and all of the classes of streams must work together with the runoff generated by the rain falling on the watershed. If forest practices are increasing the volumes of sediment dislodged above those characteristic of long-term rates that have persisted through Recent geologic time, then forest practices must also increase runoff volumes proportionally and timing of runoff to carry the sediments away. It is the BALANCE that determines the thresholds of significance, not just impossible platitudes or wishes.

Coarse sediment, that fills rearing pools, and builds up the bed of the stream to bury large woody debris and riparian vegetation, is all presumed to be derived from landslides and other hillside hillslope processes. Thus, the thresholds of significance attempt, very poorly, to evaluate the site-specific probability of increases in slope processes that would deliver such sediment to the streams. But that is only one source of coarse sediment. Another equally important (in terms of volume of sediment supplied as the result of anthropogenic activities) is the bank and bed of the stream itself. Most of the PalCo watersheds evaluated have alluvial (deposited by the stream itself) streambanks in at least the lower portions of the watercourses. More than half the length of the primary water courses in the Bear, Lower Eel, Yager, Elk and Freshwater basins on PalCo Lands have alluvial deposits along the channel banks. These are eroded under certain conditions to add gravel-sized sediment to the streambeds.

One triggering event to erode sediment from stream banks and add it to pools farther downstream is an upstream landslide. When a streambed aggrades (builds up)

following a landslide in the upper watershed that temporarily adds sediment to the river bed, a positive feedback cycle is initiated where higher streambeds cause undercutting of stream banks and toppling of riparian forest. Unless trapped behind a logjam or natural constriction, such a pulse of released self-amplifying sediment proceeds downstream – usually over a period of several heavy runoff years. We see this happening in the Lower Eel PalCo watersheds today in response to triggering many decades earlier.

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Another unevaluated triggering event to start a cycle of streambank coarse sediment erosion is a change in the frequency or frequency-magnitude of flooding. Some of the causes of such change were discussed in my PalCo SYP/HCP review under the general category of decreased interception losses. It is clear that the authors of the dEIR do not understand what frequency-magnitude concepts are. The language used in Section 3.4.3.4 shows that channel banks are not recognized as potential sources of sediment. Similarly, Table 3.6-6 ignores this very important linkage. In a place like lower Yager Creek, this linkage is probably the primary source of silviculturally derived sediment. But the real failing of the dEIR is shown in Section 3.4.3.2 that attempts to establish thresholds for changes in streamflows.

The concept of evaluation by Habitat Units (HU) that is introduced in Chapter 3.8 fails when it comes to assessment of coarse sediment inputs (cf., 3.8 p. 33-35). Because the coarse sediment impacts are primarily manifest beyond (downstream from) the sources of those sediments, and because the reinforcing feedback mechanisms associated with coarse sediment may be amplified downstream. The discussions of the import of RMZ's to fish habitats on these three pages is not in accord with generally accepted professional knowledge. As Don Erman has show for the last four decades of research publication here in California, streamside buffers have increasingly greater protective effects on aquatic habitats as a function of their widths. There is not a magic number that defines the limits of width necessary for streamside buffers. The ideas presented in Chapter 3.8 that full protection of streamside buffers greater than 100 ft wide is not necessary because of all of the corollary management practices that "set a trend" may be valid for fully balanced functioning watersheds, but these are not found on PalCo lands. The trends for much of the PalCo ownership has already "been set" in a downward degrading condition. One cannot simply sum up a series of considerations that purport to reduce individual impacts to "less than significant" as done in Chapters 3.4, 3.6 and 3.7 and then conclude that the sum is less than significant in terms of protection of habitats for target species. Because the feedbacks were not adequately considered in the former section, Section 3.8 cannot support its conclusions.

For example, Section 3.4.3.2 states that "For risk to people and property, the likelihood of changing the recurrence interval of a storm from five years to two years was used as a threshold." Although I may know what the authors intend, they have stated a hydrologic impossibility. Timber harvest has only a very remote chance of changing the frequency of Pacific frontal storms in Northern California. More likely, the authors intended to mean that if we discovered that the magnitude of a runoff event associated with a five-year storm had been occurring every two years, a threshold would have been exceeded. With a long hydrologic record and an assumption of uniformity in storm frequency (ie., ignoring El Nino type events), such a criterion might be proposed, although only very naively. Like global warming, by the time it was provable, it would be too late to reverse.

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What the dEIR authors in Section 3.4.3.2 are apparently attempting is an evaluation of the frequency-magnitude relationships of storm rainfall and resulting runoff. As shown

by CDF and as outlined in my PalCo SYP/HCP comments, this has already been demonstrated for Freshwater Creek, and has been demonstrated in the lower reaches of many other PalCo watersheds by Harvey Kelsey (*op cit*, PalCo comments). If, as suggested by the replotting of the CDF and Corps of Engineers cross-sections for Freshwater Creek, about 1 foot of aggradation has occurred in the last decades (Leslie Reid, PalCo SYP/HCP comments), then this threshold has already been exceeded. This demonstrates the non-functionality of the proposed thresholds. On Bear Creek, we see channel scour in the lower reaches of 6-10 feet associated with failure of log jams and a Humboldt Crossing in the same period. How can the dynamic properties of these streams be frozen in time to start the clock running for evaluation of net change? How can scour or fill events that take 20 years or more to reach equilibrium be evaluated? How can natural background changes in storm frequency be evaluated against runoff magnitude under saturated watershed soil conditions in an already roaded watershed? This whole section, and all of the hillslope, landslide, and stream channel stability interrelationships needs to be reconsidered. It is technically indefensible, requires information not being collected, and cannot be implemented.

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Another part of Section 3.4.3.2 attempts to dismiss the need for standards for low-flow because all silvicultural activities are expected to increase summer flows. Increase in summer low flows is probably the largest single cause of property damage in the state of California! Increases in summer low flow cause increases in mid-channel riparian vegetation. Streams that would go dry in the late summer and thus limit channel vegetation carry some water all summer after removal of a portion of the timber. This makes scour of the bed in subsequent winter flows difficult or impossible in all but the largest events (25 year or greater storm frequency-magnitudes), and thus increases the height of flooding in intermediate years, and the frequency of floods of a given depth. Changes in summer low flows are extraordinarily important and cannot be dismissed in channels that historically have a dry period in some of all of the late summers.

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3. Soil productivity (Section 3.6.3.5) is another important part of the interrelationships that are being artificially and inconclusively segregated into thresholds of concern. As soil productivity decreases, density of timber cover and depth of root mass penetration and strength of root arching to strengthen slopes and interception losses by forest canopy and runoff intensity all change in a way that negatively reinforces soil productivity. Once a productivity threshold is exceeded on a single acre of a steep slope, for example, mass wasting (landslides) and soil surface erosion increase and site productivity continues to decline. The concepts of feedback and scale are missing in this naïve attempt at segregating impacts. Once soil productivity declines, the rates of sediment delivery (independent of silviculture) generally increase in Northern California Coast Ranges. That changes the form of the stream channel necessary to transport the sediment with the water available to it, and changes the habitats along that stream. These interrelationships must be evaluated – possibly by index species concepts, or by Vigil Network channel geometry concepts or both. This effort cannot be dealt with in a piecemeal fashion.

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4. Wetland thresholds are evaluated in Section 3.7 and summarized on p. 8 of that section. This summary is so vague and non-specific that I cannot determine if the authors actually know how California's Forest Practice Rules do or do not protect wetland values. The text correctly points out that wetland values are related to water quality and that wetlands are regulated through water quality regulations. The caveats suggest limits that are "reasonable" and "as much as possible" without any specific objective or limits. Wetlands, if properly functioning, do reduce DO (dissolved oxygen). Buried trapped organic matter in wet areas is the general source of reducing conditions

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that enhance water quality as it passes through wetlands. We are not told how or under what conditions the quantity or quality of this buried organic matter is to be maintained or how the water quantity is to be maintained in wetlands.

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